



U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

15.7.3 POSTULATED RADIOACTIVE RELEASES DUE TO LIQUID-CONTAINING TANK FAILURES REVIEW RESPONSIBILITIES

Primary - ~~Effluent Treatment Systems Branch (ETSB)~~ Plant Systems Branch
(SPLB)¹

Secondary - ~~Hydrologic & Geotechnical Engineering Branch (HGEB)~~
Civil Engineering and Geosciences Branch (ECGB)²
Emergency Preparedness and Radiation Protection Branch (PERB)³

I. AREAS OF REVIEW

At the construction permit (CP) or design certification⁴ stage of review, ~~ETSB~~SPLB⁵ reviews the information in the applicant's safety analysis report (SAR) in the specific areas that follow. At the operating license (OL) or the combined license (COL)⁶ stage of review, the ~~ETSB~~SPLB⁷ review consists of confirming the design accepted at the CP or design certification⁸ stage and evaluating the adequacy of the applicants technical specifications in these areas.

1. The ~~ETSB~~SPLB⁹ determines the tanks and associated components which could contain radioactive liquids outside containment and evaluates the consequences of single failures involving these tanks and components.
2. ~~A secondary review is performed by HGEB to complete the overall evaluation. The HGEB will review information on the surface and groundwater hydrology and the parameters governing liquid waste movement through the soil. This review by HGEB is conducted as part of the primary review responsibility of SRP Section 2.4.12.~~¹⁰

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USNRC STANDARD REVIEW PLAN

Standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The standard review plan sections are keyed to the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. Not all sections of the Standard Format have a corresponding review plan.

Published standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555.

~~In addition, ETSB will coordinate the branch evaluation that interfaces with the overall review of tanks and components containing radioactive liquids outside of containment as follows: The review for Technical Specifications is coordinated and performed by the Licensing Guidance Branch (LGB) as part of its primary review responsibility for SRP Section 16.0¹¹~~

2. The SPLB determines compliance with the acceptance criteria given in subsection II based on the ECGB and PERB calculation of radionuclide concentrations at the nearest potable water supply.
3. The SPLB reviews the technical specification limiting the becquerel (curie) content of liquid-containing tanks to ensure that the technical specification is consistent with the safety evaluation.
4. The SPLB will consider the design features, e.g., steel liners or walls in areas housing components, dikes for outdoor tanks, and overflow provisions incorporated to mitigate the effect of a postulated failure.¹²

Review Interfaces¹³

In addition, ~~ETSB~~SPLB¹⁴ will coordinate the branch evaluations that interface with the overall review of tanks and components containing radioactive liquids outside of containment as follows:

1. The Technical Specifications Branch (TSB) coordinates and performs the review for technical specifications as part of its primary review responsibility for SRP Section 16.0
2. The ECGB and PERB review the selection of the components and coordinate with SPLB to ensure that the assessment considers access to the hydrosphere and the magnitude of potential dilution and decay for various pathways as well as size and inventory.
3. The ECGB and PERB calculate potential radionuclide concentrations at the nearest potable water supply using the values of hydrological parameters ECGB developed with the guidance in SRP Section 2.4.12.
4. The ECGB reviews information on the surface and groundwater hydrology and the parameters governing liquid waste movement through the soil. This review by ECGB is conducted as part of the primary review responsibility of SRP Section 2.4.12.
5. The PERB verifies that appropriate assumptions are used in calculation of the inventory of radioactive materials within tanks that are postulated to fail.

For those areas of review identified as part of the primary responsibility of other branches, the acceptance criteria and methods of application are contained in the referenced SRP section.¹⁵

II. ACCEPTANCE CRITERIA

ETSBSPB¹⁶ acceptance criteria are based on meeting the relevant requirements of the following regulations:

1. General Design Criterion 60 as it relates to the radioactive waste management systems being designed to control releases of radioactive materials to the environment.
2. 10 CFR Part 20 as it relates to radioactivity in effluents to unrestricted areas. Tanks and associated components containing radioactive liquids outside containment are acceptable if failure does not result in radionuclide concentrations in excess of the limits in 10 CFR Part 20, Appendix B, Table 2, Column 2, at the nearest potable water supply,¹ in an unrestricted area, or if special design features are provided to mitigate the effects of postulated failures for systems not meeting these limits.

Technical Rationale¹⁷

The technical rationale for application of these acceptance criteria to reviewing the postulated radioactive releases due to liquid-containing tank failures is discussed in the following paragraphs:¹⁸

1. Compliance with General Design Criterion 60 requires, in part, that the nuclear power unit design shall include means to control suitably the release of radioactive materials in gaseous and liquid effluents produced during normal reactor operation, including anticipated operational occurrences.

GDC 60 is applicable to SRP Section 15.7.3 because this section is concerned with tanks and associated components outside of the containment that could contain radioactive liquids. A single failure of these tanks could release radioactive liquids to surface or ground water and potentially endanger the public.

Meeting this criterion provides assurance that releases of radioactive material due to a single failure of liquid-containing tanks outside of the containment during normal operations or anticipated operational occurrences will not result in doses exceeding the limits specified in 10 CFR Part 20.¹⁹

2. Compliance with 10 CFR Part 20, Appendix B, requires that radioactive materials released in liquid effluents do not result in radionuclide concentrations in excess of those values listed in Table 2, Column 2 at a potable water supply in an unrestricted area.

¹"Supply" means a well or surface water intake that is used as a water source for direct human consumption or indirectly through animals, crops, or food processing.

10 CFR Part 20 is applicable to SRP Section 15.7.3 because this section is concerned with tanks and associated components outside of the containment that could contain radioactive liquids. A single failure of these tanks could release radioactive liquids to surface and ground water and potentially endanger the public. GDC 60 requires that the nuclear power unit design include means to control suitably the release of radioactive materials in gaseous and liquid effluents and 10 CFR Part 20, Appendix B provides exposure limits in the unlikely event of a single failure of liquid-containing tanks outside of the containment.

Meeting this criterion provides assurance that releases of radioactive material due to a postulated single failure of liquid-containing tanks outside of the containment during normal operations or anticipated operational occurrences will not result in releases that exceed the limits specified in 10 CFR Part 20 Appendix B.²⁰

III. REVIEW PROCEDURES

1. The ETSBSPLB²¹ will select the tanks and components for which a failure is assumed based on the nuclide concentration and the total radioactive material content in the tank and its components that will result in the highest concentrations of radioactive material at the nearest potable water supply in an unrestricted area.
 - a. The radionuclide inventory in failed components is based on assuming 80% of the liquid volume in each component and the expected failed fuel fraction, i.e., 0.12% of the fuel producing power in a pressurized water reactor (PWR) per NUREG-0017 or consistent with an offgas release rate of 0.555 MBq/sec-Mwt (15 µCi/sec-MWt)²² after 30 minutes delay for a boiling water reactor (BWR) per NUREG-0016. The radionuclide inventory in failed components is calculated based on the techniques given in Chapter 4 and Appendices A and B of NUREG-0133.
 - b. The ETSBSPLB²³ will consider the design features, e.g., steel liners or walls in areas housing components, dikes for outdoor tanks, and overflow provisions incorporated to mitigate the effect of a postulated failure. Because of the potential radionuclide inventory, the failed components that are considered are typically waste collector tanks or evaporator concentrate tanks. However, the components selected for evaluation are based on the individual plant design. Selection of the components should be coordinated with the HGEBCGB and PERB²⁴ reviewers to assure²⁵ that the assessment considers access to the hydrosphere and the magnitude of potential dilution and decay for various pathways as well as size and inventory.

Credit for liquid retention by unlined building foundations will not be given regardless of the building seismic category because of the potential for cracks. Credit is not allowed for retention by coatings or leakage barriers outside the building foundation.

2. The radionuclide concentrations at the nearest potable water supply are calculated by HGEBPERB²⁶ using the values of hydrological parameters ECGB²⁷ developed with the guidance in SRP Section 2.4.12 and using the ETSBPERB²⁸ calculated radionuclide concentration in failed components. HGEBECGB and PERB²⁹ will transmit a summary of their results to ETSBSPLB³⁰ to permit ETSBSPLB³¹ to complete the safety evaluation report (SER).
3. Compliance with the acceptance criteria given in subsection II will be determined by ETSBSPLB³² based on the HGEBPERB³³ calculation of radionuclide concentrations at the nearest potable water supply.
4. The ETSBSPLB³⁴ will review the technical specification limiting the becquerel (curie)³⁵ content of liquid-containing tanks to ensure that the technical specification is consistent with the safety evaluation. The becquerel (curie)³⁶ content is based on that quantity which would not exceed the concentration limits of 10 CFR Part 20, Appendix B, Table 2, Column 2, at the nearest potable water supply if the tank and components should fail, or will be limited to 370,000 MBq (10 curies)³⁷ in any mobile or portable tank used more than one calendar quarter.

For standard design certification reviews under 10 CFR Part 52, the procedures above should be followed, as modified by the procedures in SRP Section 14.3 (proposed), to verify that the design set forth in the standard safety analysis report, including inspections, tests, analysis, and acceptance criteria (ITAAC), site interface requirements and combined license action items, meet the acceptance criteria given in subsection II. SRP Section 14.3 (proposed) contains procedures for the review of certified design material (CDM) for the standard design, including the site parameters, interface criteria, and ITAAC.³⁸

IV. EVALUATION FINDINGS

If the ETSBSPLB³⁹ confirms that the consequences of liquid-containing tank failures would be acceptable according to the criteria stated in subsection II of this SRP section, conclusions of the following type are provided for the staff's SER:

The scope of the review included the calculation of radionuclide concentrations in the applicable failed components based upon the expected fuel failure rate for the plant and the effect of site hydrology for those systems that have not been provided with special design features to mitigate the effects of failures. Radionuclide concentrations at the nearest potable water supply were found to be acceptable. The basis for acceptance has been that the staff's review shows that the postulated failure of a tank and its associated components would not result in radionuclide concentrations in excess of 10 CFR Part 20, Appendix B, Table 2, Column 2, at the water source(s) noted above.

For those cases where special design features were incorporated to mitigate the consequences of a failure of a tank and the associated components, the following type of statement is made:

Tanks for which special design features were incorporated to mitigate the consequences of failures such as steel liners or walls or dikes surrounding the failed component tanks

and their components and tank⁴⁰ overflow provisions were evaluated and found to be acceptable. The basis for the staff's acceptance was the capability of these design provisions to prevent the release of radioactivity from entering a potable water supply system. Therefore, the staff concludes that the design provisions incorporated by the applicants to mitigate the effects of a tank and its associated components failure involving radioactive liquids are acceptable.

In any case, the staff concludes that the postulated failure of a tank and its associated components has been evaluated and the design is acceptable and meets the requirements of General Design Criterion 60 for the control of releases of radioactive materials to the environment. This conclusion is based on the following:

The applicant has met the requirements of General Design Criterion 60 with respect to the control of releases of radioactive materials to the environment by providing controls to reduce the potential impact of the failure of a radioactive liquid-containing tank and its associated components. Such a release will not result in concentrations exceeding the limits of 10 CFR Part 20, Appendix B, Table 2, Column 2 in the unrestricted area.

For design certification reviews, the findings will also summarize, to the extent that the review is not discussed in other safety evaluation report sections, the staff's evaluation of inspections, tests, analyses, and acceptance criteria (ITAAC), including design acceptance criteria (DAC), site interface requirements, and combined license action items that are relevant to this SRP section.⁴¹

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

This SRP section will be used by the staff when performing safety evaluations of license applications submitted by applicants pursuant to 10 CFR 50 or 10 CFR 52.⁴² Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications docketed six months or more after the date of issuance of this SRP section.⁴³

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced NUREGs.

VI REFERENCES

1. NUREG-0016, Rev. 1,⁴⁴ "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors."

2. NUREG-0017, Rev. 0,⁴⁵ "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors."
3. NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants."

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SRP Draft Section 15.7.3
Attachment A - Proposed Changes in Order of Occurrence

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

Item	Source	Description
1.	Current PRB name and abbreviation	Changed PRB to Plant Systems Branch (SPLB).
2.	Current SRB name and abbreviation	Changed SRB to Civil Engineering and Geosciences Branch (ECGB).
3.	Current SRB name and abbreviation	Changed SRB to Emergency Preparedness and Radiation Protection Branch (PERB).
4.	SRP-UDP format item	Added "or design certification" after (CP) to accommodate 10 CFR 50 Part 52.
5.	Current PRB name and abbreviation	Changed PRB to SPLB.
6.	SRP-UDP format item	Added "or the combined license (COL)" after (OL) to accommodate 10 CFR 50 Part 52.
7.	Current PRB abbreviation	Changed PRB to SPLB.
8.	SRP-UDP format item	Added "or design certification" after CP to accommodate 10 CFR 50 Part 52.
9.	Current PRB abbreviation	Changed PRB to SPLB.
10.	SRP-UDP format item	Relocated to "Review Interfaces," subsection 4.
11.	SRP-UDP format item	Relocated to "Review Interfaces" and modified as lead-in sentence.
12.	SRP-UDP format item	Added subsections I, 2, 3, and 4, which were excerpted from subsection III, REVIEW PROCEDURES.
13.	SRP-UDP format item	Added "Review Interfaces" to AREAS OF REVIEW and formatted into numbered paragraphs to describe how SPLB reviews aspects of the postulated radioactive releases due to liquid-containing tank failures under other SRP sections and how other branches support the review of the postulated radioactive releases due to liquid-containing tank failures. Review interfaces were excerpted from Subsection III, REVIEW PROCEDURES.
14.	Current PRB abbreviation	Changed PRB to SPLB.
15.	SRP-UDP format item	Revised to reflect the current format when the SRP section contains review interfaces.
16.	Current PRB abbreviation	Changed PRB to SPLB.
17.	SRP-UDP format item, develop technical rationale	Added "Technical Rationale" to ACCEPTANCE CRITERIA and formatted in numbered paragraph form to describe the bases for referencing the GDC.

SRP Draft Section 15.7.3
Attachment A - Proposed Changes in Order of Occurrence

Item	Source	Description
18.	SRP-UDP format item, develop technical rationale	Added lead-in sentence for "Technical Rationale."
19.	SRP-UDP format item, develop technical rationale	Added technical rationale for GDC 60.
20.	SRP-UDP format item, develop technical rationale	Added technical rationale for 10 CFR Part 20, Appendix B.
21.	Current PRB abbreviation	Changed PRB to SPLB.
22.	SRP-UDP format item, convert to metric units	Converted μ curie to megabecquerel (MBq).
23.	Current PRB abbreviation	Changed PRB to SPLB.
24.	Current SRB abbreviation	Changed SRBs to ECGB and PERB.
25.	Editorial	Changed "assure" to "ensure."
26.	Current SRB abbreviation	Changed SRB to PERB.
27.	SRP-UDP format item	Added ECGB as responsible branch for SRP Section 2.4.12 to eliminate any confusion with two secondary reviewers.
28.	Current PRB abbreviation	Changed SRB to PERB.
29.	Current SRB abbreviation	Changed SRBs to ECGB and PERB.
30.	Current PRB abbreviation	Changed SRBs to ECGB and PERB.
31.	Current PRB abbreviation	Changed PRB to SPLB.
32.	Current PRB abbreviation	Changed PRB to SPLB.
33.	Current SRB abbreviation	Changed SRB to PERB.
34.	Current PRB abbreviation	Changed PRB to SPLB.
35.	SRP-UDP format item, convert to metric units	Added the metrication name for curie (becquerel).
36.	SRP-UDP format item, convert to metric units	Added the metrication name for curie (becquerel).
37.	SRP-UDP format item, convert to metric units	Converted curie to megabecquerel (Mbq).
38.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
39.	Current PRB abbreviation	Changed PRB to SPLB.
40.	Editorial	Revised for clarity.

SRP Draft Section 15.7.3
Attachment A - Proposed Changes in Order of Occurrence

Item	Source	Description
41.	SRP-UDP Format Item, Implement 10 CFR 52 Related Changes	To address design certification reviews a new paragraph was added to the end of the Evaluation Findings. This paragraph addresses design certification specific items including ITAAC, DAC, site interface requirements, and combined license action items.
42.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard sentence to address application of the SRP section to reviews of applications filed under 10 CFR Part 52, as well as Part 50.
43.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
44.	SRP-UDP format item	The approved Rev. 1 is currently in use by the Staff.
45.	SRP-UDP format item	The approved Rev. 0 is currently in use by the Staff.

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SRP Draft Section 15.7.3
Attachment B - Cross Reference of Integrated Impacts

Integrated Impact No.	Issue	SRP Subsections Affected
	No Integrated Impacts were incorporated in this SRP Section.	